NON-PUBLIC?: N
ACCESSION #: 9411080244
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Big Rock Point Plant PAGE: 1 OF 8

DOCKET NUMBER: 05000155

TITLE:
EVENT DATE: 09/30/94 LER #: 94-007-00 REPORT DATE: 10/31/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 069

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: TA COMPONENT: ROD MANUFACTURER: G080
REPORTABLE NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On September 30, 1994, the reactor was manually scrammed at 2146 from 69% power during a planned facility shutdown for the 1994 Refueling Outage. Cooldown rate and temperature spreads between primary system equipment were maintained in accordance with Technical Specifications.

The turbine generator (T/G) controls were not operating smoothly, causing uncontrolled variances in reactor pressure control. (These oscillations had been experienced late in the operating cycle, and were exacerbated during the shutdown). Plant management deliberated for several hours on how to lower power with erratic T/G controls, and decided that a manual scram would be the preferred method. Following the manual scram, the plant equipment operated as expected.

The root cause of the erratic T/G controls was the binding of the admission valve operating piston pilot valve extension rod in its guide bushing. The extension rod and the guide bushing were cleaned and

dimensional checks performed to obtain clearance information. Prior to returning to service, the system will be tested-to ensure performance.

END OF ABSTRACT

IDENTIFICATION OF EVENT

Licensees shall report "any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS)..."

References

a. 10 CFR 50.72(b)(2)(ii), and
b. 10 CFR 50.73(a)(2)(iv)

CONDITIONS PRIOR TO THE EVENT

The reactor RCT! was operating at approximately 69% power. The control rods AA! were being inserted as the facility was in the process of shutting down for a fall refueling outage. Canal Sample Pump P! P-34 Suction Line broken; Technical Specification 13.1, Table 13-2 Action 3 (sampling) was the only limiting condition of operation present at the time of the event (This LCO neither contributed nor was affected in any way by this event). The turbine-generator TG! oscillations had been experienced late in the operating cycle, and the turbine controls had been transferred from the Initial Pressure Regulator RG! (IPR) (automatic) to the synchronous governor 65! (manual) several days prior to the shutdown.

DESCRIPTION OF THE EVENT

On several occasions prior to shutdown the plant experienced oscillations in steam flow affecting Primary (Reactor) System SB! pressure. The turbine engineer investigated and concluded that either the IPR or the admission valves FCV! were sticking or "hanging up". To validate the engineer's theory, the turbine TUR! controls were transferred from automatic (IPR) to manual operation (synchronous governor) in accordance with facility Technical Specifications and procedures. The IPR was removed from service on September 28, 1994, and the turbine placed on the synchronous governor. When on the synchronous governor the turbine admission valves remain in a fixed position; unlike IPR control, in which the admission valves are automatically repositioned to maintain steamline pressure. Steam flow, therefore, remains essentially constant when on manual control. No oscillations occurred while operating on the synchronous governor at steady state conditions.

The transfer of control proceeded normally until the point that the starting handwheel/load limiter (which presets the amount of load the unit may carry) was adjusted. When attempting to position the starting wheel/load limiter, steam oscillations recurred. The load limiter was then re-positioned until the oscillations ceased. The recurring oscillation suggested that the root cause of the erratic turbine controls existed with the admission valves.

During the planned power reduction for the scheduled refueling outage on September 30th, 1994, the admission valves were being closed using the

synchronous governor. At 1855, a larger than expected admission valve closure caused primary system pressure to rise above the turbine bypass valve FCV! setpoint (reactor pressure plus 15 psi), opening the bypass valve. At this point the operating crew stopped their attempts to manually close the admission valves, stabilizing the plant. Management was consulted prior to continuing plant shutdown.

The operating crew was in a situation where they did not have an approved procedure to respond to the inadequate turbine controls. The existing procedure, ONP 2.23 "Loss Of Pressure Control System (IPR and Bypass Valve)" is written to respond to the following situations:

- Initial pressure regulator malfunction opens the turbine admission valves.

- Turbine bypass valve malfunction opens turbine bypass valve.

- Initial pressure regulator closes turbine admission valves.

- Malfunction closes the bypass valve (this assumes the plant is using the synchronous governor to position the turbine admission valves and the IPR is out of service).

The ability to smoothly control reactor pressure with the turbine admission valves as power was reduced became questionable during the shutdown. The entry conditions for ONP 2.23 were never satisfied. Therefore the operating crew and plant management made the decision to manually scram the reactor rather than try to continue plant shutdown by working around the malfunctioning turbine controls. Lacking an approved procedure specifically written for this situation, the operators followed the guidance provided in Administrative Procedure 2.1.2 "Operations Documents". Guidance is provided in this procedure in the establishment of Temporary Operating Instructions. In this instance the instructions were to initiate a manual reactor scram and follow existing scram recovery procedures as required. The reactor was manually scrammed at 2146 from 69% power. By manually scramming the reactor the turbine stop valve ISV!, which is upstream of the admission valves, is automatically tripped; isolating the admission valves from reactor pressure.

There has never been a similar event in plant history. In the past only a portion of the admission valve control has malfunctioned. In general these malfunctions have caused either an automatic reactor scram (due to admission valve closure) or a manual shutdown where either the IPR or the synchronous governor was available to close the admission valves.

ROOT CAUSE EVALUATION

The root cause of the steam flow oscillations was the binding of the admission valve operating piston pilot valve extension rod ROD;G080! in its guide bushing.

Observations:

- Between September 18 and September 28 there were approximately fifteen occurrences of steam oscillations (reactor power oscillated in the range of 6 to 8%). During this period of time, the turbine admission valves were under the control of the IPR.

- The reactor was in a coast down mode with all rods AA! out. Reactor pressure was slowly decreasing with time, necessitating the need for periodic corrections by the IPR. The IPR needed to position the admission valves in the closed direction to maintain reactor pressure.

- On a few occasions, the reactor pressure had drifted down, requiring manual adjustment of the IPR pressure setting. When adjusting the IPR, there usually would be no initial response, then the pressure would jump (overshoot) and oscillations would occur. The oscillations typically dampened out in five to ten minutes.

- On September 28 at 1516 the turbine was placed under the control of the synchronizing governor and the IPR was tripped. The next shift adjusted the load limiter and experienced more steam flow oscillations while making changes to reactor pressure with the synchronizer and load limiter.

- There were no oscillations while under synchronous governor control unless adjustments were attempted.

- While initiating plant shut down on September 30, 1994, there was no initial valve response from changes made at the synchronizer handswitch in the control room. The changes in synchronizer position were observed at the turbine standard. Eventually the valves responded, but by overshooting and oscillating. The undesirable valve response ultimately lead to the decision to manually SCRAM the reactor.

- After the manual reactor SCRAM the turbine admission valves closed to 58 degrees cam angle (30% open) and then drifted closed over the next 4-1/2 hours.

Initial Testing Results:

- A test program was implemented, following shutdown for the 1994 Refueling Outage, before taking the turbine oil pumps out of service.

With the auxiliary oil pump P! running, the turbine trip was reset and the admission valves went from closed to wide open.

- The admission valves did not respond to changes from the load limiter or the IPR.

- The valves would drift closed at a uniform, steady rate when the auxiliary oil pump was shut off.

- A broken lever was found which connects the rolling rod ROD! to the operating piston pilot valve operating linkage.

1994 Refueling Outage Inspection Findings

- The linkage train between the rolling rod and the pilot valve extension rod could not be moved until the connecting pin to the pilot valve extension rod was removed. The linkage was then very free to move.

- The pilot valve extension rod could not be moved by hand. The pilot valve extension rod and guide bushing were removed as an assembly with the pilot valve attached. The pilot valve slid out of its bushing freely.

- The extension shaft had to be driven through its guide bushing to remove it.

- The threaded end of the pilot valve had 0.024 inches total indicated readout (T.I.R.).

Discussion

Oscillations in a control system are typically caused by friction within the control components or lost motion due to excessive clearances between parts which are designed to move in concert. The observations and inspection findings are consistent with the diagnosis that friction was present.

As the reactor pressure slowly decreased, the IPR would change its output rod position which in turn acts upon the load limit pilot, changing the primary pilot output. This in turn causes a pressure change acting upon the "S" relay RLY! which repositions the rolling rod, and through suitable linkage, the operating piston pilot valve. The pilot valve extension rod required more force than usual to move it in its guide bushing. Therefore the "S" relay would not move until the pressure change to it was sufficient to overcome the pilot valve extension rod friction.

Once the static friction between the extension rod and bushing was overcome, the pilot would overtravel and require compensation in the opposite direction. The cycle would repeat until it finally dampened out. These were the oscillations which were observed.

The same response would occur when the operator would make changes with the synchronizing governor handswitch HS!. The pressure beneath the "S" relay would change which, through the rolling rod, would change the position of the main piston pilot. But the "S" relay could not move until the pressure change was sufficient to overcome the friction in the extension rod and guide bushing.

Because the IPR would continuously monitor the pressure and make frequent incremental corrections, the oscillations occurred more frequently while under IPR control. While on the synchronous governor control, the valves were held in a steady position unless the operator made a change. Therefore, there were no oscillations while operating on the governor during steady state operation.

The lever broke when the turbine was being tested after shutdown. If it had broken before that, the admission valves would have remained open when the turbine was tripped because the "S" relay could not have transmitted the close signal to the power piston pilot relay.

When the turbine was latched for testing, the admission valves stroked wide open. This would occur if the load limit was at the upper limit stop. The lever was not broken at this time because the act of latching, allows pressure to build up beneath the "S" relay to position the power piston pilot and thus open the valves. If the lever had been broken when the turbine was first reset for testing, the act of latching would not have been transmitted to the operating piston to open the valves.

When the load limiter local handwheel was adjusted, there was no change in valve position. This is when the lever probably broke. At the same time, the force which broke the lever also contributed to slight bending of the upper threaded area of the pilot valve, creating the runout. The valves remained open from this point on, as long as the auxiliary oil pump was in operation, regardless of the turbine trip status.

When the auxiliary oil pump was shut off, the valves drifted closed in about 15 seconds with no indication of binding or sticking. This indicated that the valve train linkage was not binding or sticking.

These observations can be explained by the fact that the pilot valve extension shaft was binding in a position that ported the hydraulic oil to the piston. With a broken lever, movement of the "S" relay, by any means can not be transmitted to the pilot relay. Therefore, load limiter position or the turbine reset status had no affect on the valve position, just the presence of hydraulic oil pressure beneath the power piston.

The power piston movement did not provide follow-up to the pilot relay because the stuck extension rod prevented pilot relay movement. The follow up lever fulcrumed at the extension rod and the follow up movement was transmitted to the rolling rod linkage instead. Because of the broken lever, these movements were never opposed by the "S" relay.

The sticking of the extension rod was caused by small particles of rust, scale or dirt getting caught in between the clearance between the rod and the bushing. The upper part of the bushing is chamfered inward and may act as a funnel to channel particles into the clearance. The pin attaching the extension rod to the actuating linkage was dry and had dropped small particles of rust onto the upper spring seat. Some of these particles may have worked their way into the bore of the bushing.

The upper part of the bushing is exposed to atmospheric pressure beneath the front standard dust cover. The lower section of the bushing is exposed to the environment within the front standard enclosure. This is an oily mist under a slight vacuum (0.1 inches - 0.5 inches water column). It is conceivable that over a long period of time that dust and dirt can be drawn into the clearance and build up. There is very little movement of the extension rod during normal operation which could act to dislodge any buildup which might accumulate in the clearance.

Another source for particles is the center section of the bushing which is recessed and was rusted.

CORRECTIVE ACTION

Immediate:

1. The extension rod and the guide bushing were cleaned and dimensional checks were performed to obtain clearance information. The clearance was found to be acceptable with 0.005 inches on diameter. The surface finish of the rod and bushing was acceptable with no scoring or galling.

After cleaning, the extension shaft, pilot valve, and bushing were reassembled and freedom was checked. Although they moved freely by hand, there were some areas which were binding slightly.

The extension rod and pilot valve were measured for runout in V-blocks. The end of the pilot valve was found to have 0.024 inches T.I.R. at the threaded portion of the upper end. This was straightened to within 0.002 inches T.I.R. The runout was not the original cause of the binding.

Turbine oil was used as a lubricant for the extension rod at assembly. The entire assembly was verified to be free by hand when reinstalled.

2. The "S" relay was also disassembled and inspected. The piston to bore clearance was measured and found to be 0.003 inches on diameter, which is acceptable. Some dirt was found in the assembly and all parts were cleaned. There was no evidence that the relay had been sticking. All parts were verified to move freely when

reassembled.

3. The broken lever was removed from the rolling rod and a new one has been fabricated.

4. The rolling rod was slightly stiff in its bearings, but could still be moved by hand. The bearing surfaces were cleaned up and lubricated with turbine oil. The rolling rod moved easily by hand following this maintenance.

5. All other linkages were inspected and found to be free without friction or binding.

6. Before the end of the current refueling outage the system will be tested to ensure acceptability for return to service.

CORRECTIVE ACTION TO PREVENT RECURRENCE

1. Revise the requirements of SOP-13, Turbine Generator and ONP 2.23, "Loss Of Pressure Control System (IPR and Bypass Valve)" to provide direction to the operators on a course of action when there is indication that control of the turbine admission valves by all of the normal means (IPR, synchronous governor, load limiter) is compromised)

This action will be complete April 17,1995.

SAFETY SIGNIFICANCE

The analyses contained in Chapter 15 of the FHSR do not credit the turbine admission valves as a means of isolating the primary system. In general if isolation is required the main steam isolation valve ISV! (MSIV) is used. Should a transient occur and the admission valves fail open a concern exists if the turbine stop valve also remained open. In this situation the plant would probably exceed the normal cooldown rate until such time as either the stop valve or the main steam isolation valve could be closed. If isolation still could not be made this event would be equivalent
o a steam line break outside containment NG!. The radiological consequences of such a break are discussed in section 15.6.3 of the FHSR and conclude that the calculated doses do not exceed the dose design guidelines; therefore the proposed limits were acceptable. Thus the plant was not in an un-analyzed condition since the turbine stop valve and the main steam valve (MSIV) were available.

ATTACHMENT TO 9411080244 PAGE 1 OF 1

Consumers
Power Patrick M Donnelly
Plant Manager

POWERING
MICHIGAN'S PROGRESS

Big Rock Point Nuclear Plant, 10269 US-31 North, Charlevoix, MI 49720

October 31, 1994

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-155 - LICENSE DPR-6 - BIG ROCK POINT PLANT - LICENSEE EVENT
REPORT (LER) 94-007; MANUAL REACTOR SCRAM DURING PLANNED PLANT SHUTDOWN.

Licensee Event Report (LER) 94-007: Manual Reactor Scram during Planned Plant Shutdown, is attached. This event is reportable to the Nuclear Regulatory Commission in accordance with 10 CFR 50.72(b)(2)(ii) and 10 CFR 50.73(a)(2)(iv).

Patrick M Donnelly
Plant Manager

CC: Administrator, Region III, USNRC
NRC Resident Inspector - Big Rock Point

ATTACHMENT

A CMS ENERGY COMPANY

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